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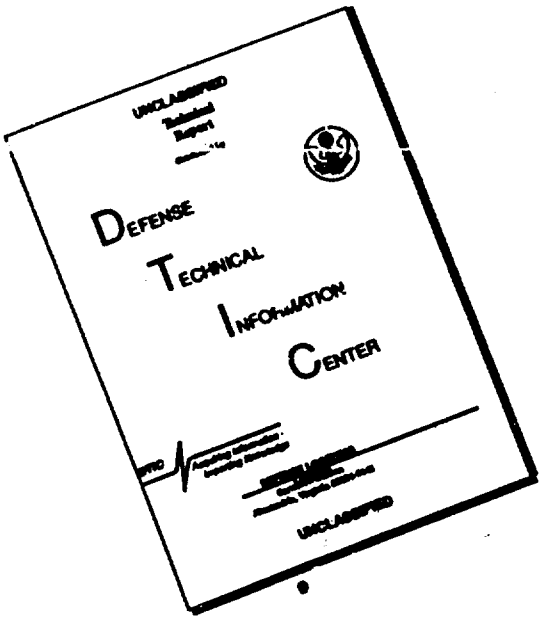

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SHORT COMMUNICATION

Mosquitoes (Diptera: Culicidae) Captured in the Iquitos Area of Peru

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ABSTRACT A mosquito capture program was initiated to study mosquito species and their potential for arboviral transmission in the Peruvian Amazon. More than 35,000 mosquitoes of 13 different genera and at least 25 species were captured in urban and sylvan sites in the Iquitos area. These findings represent the first published list of Peruvian mosquitoes since 1971 and the first such list from the Peruvian Amazon.

KEY WORDS Culicidae, Peru, Peruvian Amazon

CONTINUED HUMAN DEVELOPMENT of the Amazon Basin will undoubtedly bring man into more frequent contact with a variety of highly incapacitating arboviral fevers. In Peru, the following arboviruses have been reported: Mayaro, Oropouche, Guama, Oribora-Itaqui, Marituba, Carapara-Apeu, yellow fever, dengue, Venezuelan equine (VEE), eastern equine (EEE), and St. Louis (SLE) encephalitides (Buckley et al. 1972; Madalengoitia et al. 1973; Sherer et al. 1975 a,b; Mendez et al. 1984; Colan et al. 1991).

Previous arthropod arboviral isolations from the Peruvian Amazon relied on the use of pools of unidentified female mosquitoes (Sherer et al. 1975 a,b), thus very little is known about species involved in arbovirus transmission. In addition to a dearth of information regarding arboviruses and their vectors, little recent information exists about the mosquito fauna of the region (Belkin et al. 1968, Morales-Ayala 1971).

In an effort to learn more about the mosquito vectors of arbovirus in this region, a study involving the collection, identification, and culturing for possible virus isolation was begun in 1988. This report deals specifically with the capture methods and species composition.

Materials and Methods

Study Sites. Mosquitoes were collec 1988 to 1991 at three sylvan sites near tl Iquitos, Department of Loreto, Peru. Situated on the Amazon River (3.7°S, 73.3°W) near the junction of many of its tributaries, Iquitos is a crossroads for air and river traffic into and out of the western Amazon basin. The typical vegetation outside the city is tropical rain forest, the mean annual temperature is >25°C, and the annual rainfall exceeds 250 cm. (Peñaherrera del Aguila 1989).

Site 1 was a large wooded area on the grounds of the Peruvian Naval Hospital, located just north of Iquitos. Sites 2 and 3, Quisto Cocha Army Base and Puerto Almendras, respectively, are located approximately 20 and 25 km WSW of Iquitos, respectively (Fig. 1). In both of those locations, trapping was conducted in jungle >1 km from human habitation. Additional mosquito trapping was conducted sporadically at various urban sites (plazas, cemeteries, and houses) within Iquitos.

Mosquito Collections. In total, eight different capture methods were used intermittently in the three sylvan sites: modified canvas Shannon traps (Barretto & Coutinho 1940) used with light or human bait, CDC Model 512 traps (John W. Hock, Gainesville, FL) baited with light or dry ice, Davies' hamster-baited suction traps, No. 10 Trinidad chicken-baited traps, human bait catches, and resting place searches using hand-held aspirators (Service 1976). Resting place and human bait catches were used in the urban habitat.

Trapping in the sylvan sites was conducted from 1000 to 1300 and 1700 to 2000 hours. Col-

The opinions and assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the views of the U.S. Navy. In conducting the research described in this report, the investigators adhered to the "Guide for the Care and Use of Laboratory Animals," as prepared by the Committee on Care and Use of Laboratory Animals of the Institute of Laboratory Animal Resources Commission on Life Sciences–National Research Council.

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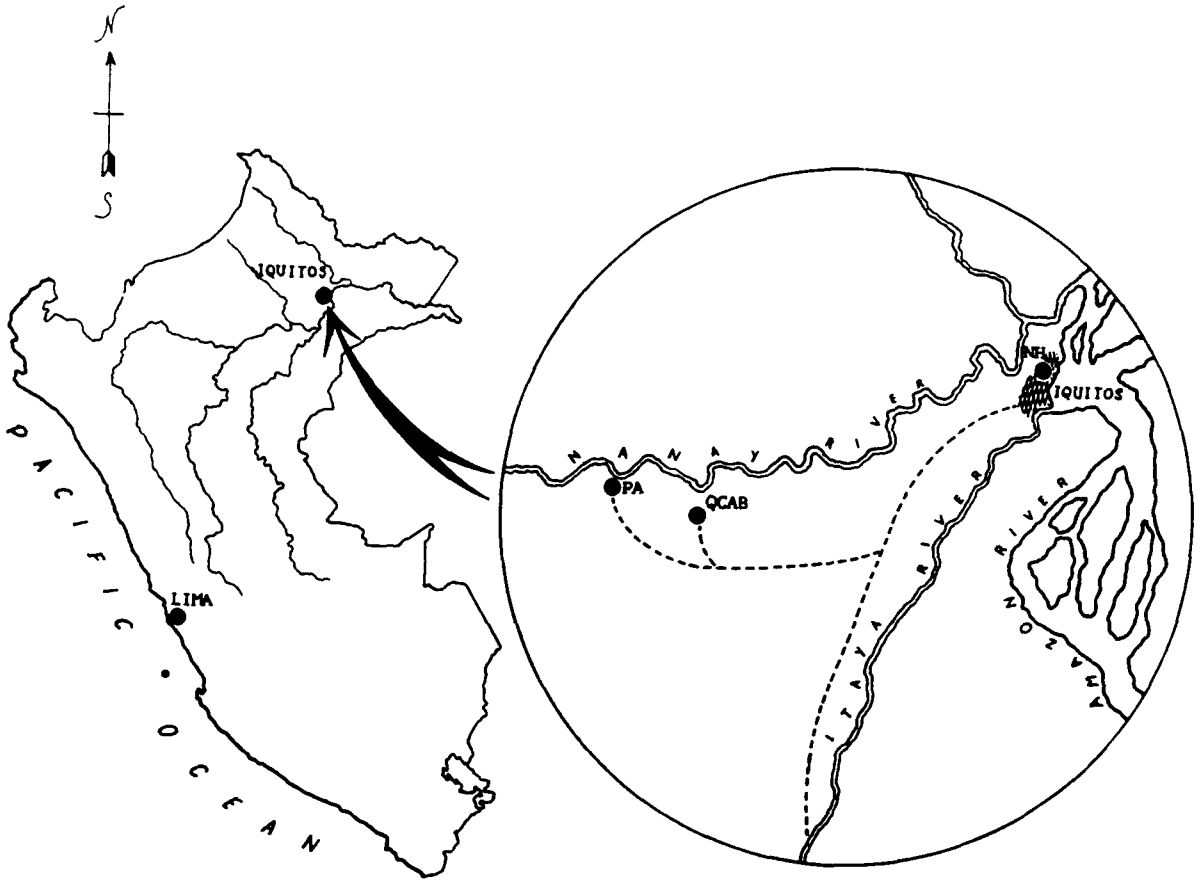

Fig. 1. Map showing location of Iquitos and sylvan study sites. NH, Naval Hospital; QCAB, Quisto Cocha Army Base; PA, Puerto Almendras.

lections in urban areas were made between 1000 and 1300 hours. All-night trapping was conducted in Quisto Cocha a few nights in 1991 during an outbreak of *Plasmodium vivax* malaria.

All mosquito catches were placed immediately in coolers with dry ice for transport. In the laboratory, they were identified, grouped into pools of 20 or more, then frozen to −70°C and shipped to our facilities in Lima for virus isolation. Mosquitoes were identified to species using several references (Lane 1953, Guedes & de Souza 1964, Forattini 1965, Faran 1980, Wilkerson 1988). Some species confirmations were made through collaboration with the Walter Reed Biosystematics Unit, Museum Support Center, Smithsonian Institution, Washington, DC. Voucher specimens will be held at our NAMRID laboratory for future reference.

Results and Discussion

During 1988–1991, 35,502 mosquitoes belonging to 13 different genera were captured (Table 1). The 40 taxa include 25 that were identified to species. An additional 12 entries were consistently and individually recognizable and are listed, although they await final species confirmation. These include two possible species complexes designated *Culex declarator* Dyar & Knab complex and *Cx. evansae* Root complex, one large group of similar mosquitoes designated *Cx. (Melanoconion)* spp., and one small group designated Sabethini group, any one of which may in reality include several different species. Finally, another three entries are listed which include groups of mosquitoes not identifiable to the species level because of the poor physical condition of the specimens.

In Table 1, the type of trap in which each species was captured is indicated. Trap effort was not uniform; thus this qualitative information should be considered to assist in the decision of which traps to use in future work.

The total number of trap attempts for each of the years 1988–1991, respectively, was 30, 162, 51, and 91. The approximate number of hours each trap method was used are as follows: Shannon trap–light, 12 h; CDC trap–light, 120 h; human bait, 224 h; resting place, 32 h; CDC–dry ice, 100 h; Shannon trap–human bait, 140 h; Trinidad #10, 20 h; and Davies' trap, 20 h.

Reports of mosquitoes attracted during the day and early evening to animal and human-baited traps in the Iquitos area are rare and to our

Table 1. Trap type, location, and mosquito species captured in the Iquitos area, 1988–1991

Species[a]	No. specimens[b]			Trap type[c]							
	Sylvan	Urban	Total	1	2	3	4	5	6	7	8
Aedeomyia squamipennis Lynch Arribalzaga*	1,097 4♂	24 —	1,121 4♂	—	X	X	—	X[d,e]	X	—	X
Aedes aegypti (L.)	1	807 516♂	808 516♂	—	—	X[d,e]	X	—	X	—	—
Ae. fulvus (Wiedemann)	175	—	175	—	X	—	—	X	X[d]	X	—
Ae. near *serratus* (Theobald)*	2,355 20♂	9	2,364 20♂	—	X[e]	—	X	X	X[d]	—	X
Anopheles fluminensis Root	1	—	1	—	—	—	—	—	X	—	—
An. mattogrossensis Lutz & Neiva	1,071 7♂	—	1,071 7♂	—	X[e]	X	—	X	X[d]	—	X
An. mediopunctatus (Theobald)	6	—	6	—	—	—	—	—	X	—	—
An. nuneztovari Galbadon*	36 1♂	1	37 1♂	—	—	X[d]	—	X	X	—	—
An. oswaldoi (Peryassu)*	8	—	8	—	—	X[d]	—	—	X	—	—
An. triannulatus (Neiva & Pinto)*	11	—	11	—	—	X	—	X	X[d]	—	—
An. (Stethomyia) spp	61 1♂	1	62 1♂	—	—	X	—	X	X[d]	—	—
*An. spp***	231 4♂	20 8♂	251 12♂	—	X	X	X	X	X	—	X
Coquillettidia arribalzagae (Theobald)	2	—	2	—	—	—	—	—	X	—	—
Cq. venezuelensis (Theobald)	978 136♂	9 1♂	987 137♂	—	X	X	X	X	X[d]	X	X
Cq. spp**	341 49♂	5 1♂	346 50♂	—	X	—	X	X	X	X	—
Culex adamesi Sirivanakarn & Galindo	1,120 22♂	3	1,123 22♂	—	X[e]	X	X	X	X[d]	—	X
Cx. amazonensis (Lutz)	1,144	—	1,144	—	X[e]	—	X	X	X[d]	—	X
Cx. (Carrollia) spp	1		1	—	—	—	—	X	—	—	—
Cx. corniger Theobald	573 1♂	11	584 1♂	—	X	—	X	X	X[d,e]	—	X
Cx. declarator complex Dyar & Knab	2,005 100♂	102 32♂	2,107 132♂	—	X	X	X	X[e]	X[d]	X	X
Cx. evansae complex Root	392 273♂	3 1♂	395 274♂	—	X[e]	X	X	X	X[d]	—	—
Cx. (Melanoconion) spp.*	9,494 800♂	114 33♂	9,608 833♂	X	X	X	X	X	X[d]	X	X
Haemagogus sp.	3	—	3	—	—	—	—	X	X	—	—
Limatus sp.	76 8♂	—	76 8♂	—	—	X	X	X	X[d]	—	
Mansonia amazonensis (Theobald)	1,075 83♂	6	1,081 83♂	—	X	X	X	X	X[d,e]	—	X
Ma. flaveola (Coquillett)	10	—	10	—	X	—	X	X	X	—	—
Ma. humeralis Dyar & Knab	184 16♂	16	200 16♂	—	X	X	—	X	X	—	X
Ma. indubitans Dyar & Shannon	1,271 57♂	95 2♂	1,366 59♂	—	X	X	X	X	X[d,e]	—	X
Ma. spp**	120 2♂	3	123 2♂	X	—	X	—	X	X	—	X
Psorophora albigenu (Peryassu)*	2,069 1♂	44	2,113 1♂	—	X[e]	X	X	X	X[d]	—	—
Ps. cilipes (F.)*	18	—	18	—	X	—	—	X	X	—	—
Ps. cingulata (F.)*	112	—	112	—	X	—	—	X	X[d]	—	X
Ps. ferox (Von Homboldt)*	53	1	54	—	—	—	—	X	X[d]	—	—
Ps. lutzii (Theobald)*	5	—	5	—	—	—	X	—	X	—	—
Ps. near *albigenu* (Peryassu)	3,500 40♂	3	3,503 40♂	X	X	X	X	X[e]	X[d]	X	X
Sabethes belizarioi Neiva	1	—	1	—	—	—	—	—	X	—	—
Sabetheni tribe	834	23	857	—	X	X	X	X[e]	X[d]	—	—
Toxorhynchites sp.	1	—	1	—	—	—	—	—	X	—	—
Trichoprosopon digitatum (Rondani)*	7	—	7	—	—	—	—	X	X	—	—
Uranotaenia spp	1,094 227♂	98 91♂	1,192 318♂	X	X	X	X	X	X[d,e]	—	—
Total	—	—	35,502	—	—	—	—	—	—	—	—

[a] *, identification confirmed by Walter Reed Biosystematics Unit, Museum Support Center, Smithsonian Institution, Washington, DC; **, not identifiable to species.

[b] Numbers indicate ♀♀, unless otherwise indicated.

[c] 1, Shannon–light; 2, CDC–light; 3, human bait; 4, resting place; 5, CDC–dry ice; 6, Shannon–human bait; 7, Trinidad #10; 8, Davies.

[d] Most frequently caught with this trap.

[e] Highest one-time catch with this trap.

knowledge have not been published in the English language literature. Based on the most recent list of mosquitoes of Peru (Morales-Ayala 1971), it appears that at least four of the species captured (*Culex adamesi* Sirivanakarn & Galindo, *Cx. amazonensis* (Lutz), *Cx. evansae* Root, and *Psorophora cilipes* (F.)) had not been reported previously to occur in Peru. Six other species (*Psorophora albigenu* (Peryassu), *Ps. cingulata* (F.), *Ps. ferox* Humboldt, *Ps. lutzii* (Theobald), *Sabethes belisarioi* Neiva, and *Trichoprosopon digitatum* (Rondani)) previously had not been reported to occur in the political department of Loreto, in which Iquitos is located.

In the sylvan sites, the human-baited Shannon traps collected the greatest diversity of mosquitoes; 39 of 40 taxa were captured in that manner. Twenty-one of the 40 taxa were captured most frequently with this same method. However, the dry-ice and light-baited CDC traps worked well, required considerably less labor, and were each responsible for the highest one-time captures of several different species. The human bait catches and resting collections were successful, accounting for approximately half of the total species captured. Three other methods, the light-baited Shannon, Davies, and No. 10 Trinidad traps were less efficient and were not used after the first 2 yr.

Several of the mosquito species captured in this study are of interest because of their potential role as vectors of arbovirus in the Peruvian Amazon. *Cx. adamesi,* one of several members of the *Culex* subgenus *Melanoconion,* is of particular interest. This species and subgenus previously has been implicated as being involved in enzootic activity of both EEE and VEE viruses in Venezuela (Walder et al. 1984), Ecuador (Calisher et al. 1980), Brazil (Calisher et al. 1982), and Argentina (Mitchell et al. 1985) and may play a similar role in the Peruvian Amazon. *Culex amazonensis* has been incriminated as a possible vector of EEE virus in Ecuador (Calisher et al. 1980). In addition, *Culex declarator* Dyar & Knab has been implicated in SLE virus transmission in the Brazilian Amazon (Pinheiro 1980). Virus isolations also have been made of Gamboa and vesicular stomatitis New Jersey viruses from *Aedeomyia squamipennis* Lynch Arribalzaga and *Mansonia indubitans* Dyar & Shannon, respectively, in Ecuador (Calisher et al. 1983). *Aedes aegypti* L. captured during this study in urban Iquitos sites were positive for dengue virus (DEN-1) (Phillips et al. 1992).

It is obvious from these results that much remains to be learned about the mosquitoes present in this biologically rich geographic region. Arbovirus isolation from these mosquito species is currently under way and should reveal some important results. As further development and population growth occur in the region, knowledge of the arbovirus disease agents and vectors will become increasingly important.

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